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AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 190

THE SHORT "SCYLLA" COMMERCIAL AIRPLANE (BRITISH)

An All-Metal Biplane

Washington
May 1934

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THE SHORT "SCYLLA" COMMERCIAL AIRPLANE (BRITISH)*

An All-Metal Biplane

The Short "Scylla" is a 39-passenger landplane with four Bristol Jupiter XF BM engines.

Although it has a superstructure identical with that of the "Scipio" class flying boats, the conditions to be met in a fuselage of a landplane differ so much from those for which a flying-boat hull are designed that in the "Scylla" the structural methods employed bear little resemblance to those of boat hulls. The structure is entirely metallic, including the secondary structure and the outer skin. The only exception is formed by some of the cabin furnishings, which are of wood veneers, as selected by Imperial Airways.

The primary fuselage structure includes the four longerons, a number of formers, and panel bracing arranged variously in the form of letters N and X. The N formation is used in the majority of the bays in the fuselage sides, the X form being confined to the bay between the wing spar bulkheads, where the stresses are greater.

A secondary structure, consisting of light stringers, is attached to the members of the primary structure by riveting, gusset plates, etc. And finally, the outer skin, which has spaced longitudinal corrugations, is riveted to the flanges of primary and secondary structure members. Figures 6 and 7 make the system quite clear. The sketches show details of the various joints, the location of which is denoted by reference letters and figures in the larger sketch.

Channel sections of sheet duralumin are used extensively. The longerons are built up to form box sections with sharp inner and rounded outer corners. The inner longeron strip is of angle section, with the free edges turned outward. Into the angle of this strip is riveted a stiffener, also of angle section, but with its edges turned inward, as shown in the sketch at A. The outer covering

*From Flight, April 5, 1934.

strip is of half-round section, and it will be noted that in this, as in all other members in the fuselage, all flanges are arranged to be readily accessible for riveting.

Sides as well as roof and floor of the "Scylla" are slightly curved, the main formers having straight inner and curved outer edges. They are of rectangular box section, with two sides flat and two corrugated. In roof and floor the transverse members are Warren girders, the floor members particularly being closely spaced and fairly stout, to carry the weight of more than 40 people.

As already mentioned, the specially strong formers which carry the wing attachments are of box section. The loads from the lower wing spars are carried across the fuselage by tubular members, those of the rear spar sloping down slightly to give the lower position required by the angle of incidence. The wing fittings on the fuselage are shown in figure 8, that for the rear spar being on the left.

In view of the fact that the superstructure of the "Scylla" is identical with that of the "Scipio" little need be said about the wing structure. The spars are of duralumin, and are of box section with corrugated sides, top, and bottom. The wing ribs are also of duralumin, and the material is used mainly in tubular form, as indicated in the wing sketches. (See figs. 9, 10, 11.)

Four Bristol "Jupiter" engines, type XF BM, are mounted abreast in the gap between the wings, and drive wooden four-bladed propellers. The tips of the inner propellers clear the top corners of the fuselage by a few inches only. Should it at any time be desired to fit other engines, provision has been made for this to be done. The fuel is carried in three tanks in the top wing, the total capacity being 625 gallons (2,841 liters), or sufficient for approximately six hours. The fuel system is so arranged that all the engines can be fed from any tank through a common collector box. Each tank can be cut off from the system by means of a control in the fuselage. The oil tanks are located behind the engines, one in each nacelle. Starting is by means of a Bristol type gas starter housed in a small compartment on the port side, in the buffet.

The landing gear is of the divided type, each half consisting of a tripod composed of the telescopic leg and two struts forming a V (fig. 12). Owing to the angles on the various struts, the loads in the telescopic legs are

large, somewhere in the region of the total weight of the airplane on each leg. The large loads have necessitated some very substantial forgings in the landing gear, but without altering the wing structure it is difficult to see how they could be reduced. Dunlop 22 by 26 inch wheels are used, and brakes are fitted. These are differentially controlled by the pilot, and as the tail wheel is fully castering the large airplane can be maneuvered very readily on the gournd (fig. 13). A hydraulic shock absorber is incorporated in the tail wheel mounting.

An unusual feature of the layout of the "Scylla" is the large proportion of the fuselage space which is occupied by cabins, etc. The accommodation plan will show that only the stern quarter or so of the total fuselage length is empty. This wide distribution of the load will necessitate careful trimming, (fig. 14), and to facilitate this a special luggage compartment is provided between the two lavatories on the starboard side. This compartment is intended to be used for trimming the airplane with various loads. If the airplane trims tail down, luggage will be transferred from the main luggage hold behind the cabin to the forward luggage compartment (fig. 15).

In the extreme nose of the fuselage is the pilots' cabin. This cabin is entirely covered in, but sliding side windows and roof hatches are fitted. (See fig. 16.) Side-by-side seating and dual controls are provided (fig. 17) and the instrument board is particularly complete, including in addition to the Smith's instruments a Sperry gyro compass, artificial horizon and a drift indicator, and indirect lighting.

Behind the pilots' seats is the wireless installation, which includes a Marconi type A.D.41A/42A set and direction-finding gear. The aerial is led out through the floor of the fuselage.

Immediately aft of the pilots' compartment is the forward cabin, which has seating accommodation for ten passengers (figs. 18, 19). As in the after cabin, the seats are arranged facing each other, six on one side and four on the other. There are large tables between the seats, and a clear gangway down the middle. The decorations are pleasing, and there is an air of speciousness rarely found on an airplane (fig. 20). Plenty of room everywhere is the feeling one has on entering the cabin, and this applies to head

room, leg room and elbow room. The forward cabin has been set aside for those passengers who wish to smoke.

The space forward of the wing spar bulkhead frames has been set aside for lavatories, luggage compartment and buffet. As already mentioned, the luggage compartment on the starboard side is used for trimming purposes. On the port side is the buffet, which is provided with every facility for serving meals, the equipment, including an ice chest, fruit racks, wine case, sink, cupboards, etc. If deemed necessary, two stewards will have room enough for their simultaneous duties in attending to the requirements of passengers.

The after cabin is arranged in a manner similar to that adopted for the forward cabin, but is larger and seats 29 passengers. The windows are large, and in dull weather extra lighting is provided by dome lights in the roof. Pendant lamps are provided over each table. Above the windows are racks for light parcels.

For heating the cabins muffs are fitted around the exhaust tail pipes, the hot air being led to light aluminum ducts situated at floor level, at the sides of the fuselage. The amount of hot air entering can be regulated by means of circular diaphragm shutters. Fresh air ducts are fitted above the tables, and air is exhausted from the cabins by venturi type exhausters.

Experience is not yet available concerning the absence of noise in the cabins of the "Scylla," but as the "Scipio" class flying boats are remarkable for their quietness, there is reason to expect the cabins of the "Scylla" to be well above the average standard in this respect also.

Access to the cabins is by two doors, both on the port side. The main entrance is at the back, behind the after cabin, and as the rear portion of the fuselage is low over the ground when the tail is down, it is possible to step straight in, although normally low steps will probably be used. Thr front door is situated just aft of the pilots' cockpit, and gives access to a vestibule from which another door leads into the smokers' compartment. When the airplane is standing with its tail on the ground, this door is rather high in the air, and fairly tall steps will be necessary. This door is also the one which will be used by the crew in getting into and out of the airplane.

It is of interest to point out that when the full quantity of gasoline is carried, and due allowance is made for its weight and the weight of oil and a crew of four, the pay load (i.e., for 600 miles' range) is approximately 5,250 pounds. It would appear that this will not permit of the airplane carrying the full complement of 39 passengers if these are all of the normally assumed average weight, as the 5,250 pounds of pay load corresponds to 39 persons at an average weight of about 135 pounds. It is, of course, possible that a certificate of airworthiness may be obtained for a greater gross weight than 33,500 pounds, in which case, the full complement of full-weight passengers could be carried.

The "figure of merit," the ratio of gross weight to tare weight of aircraft, for the Short "Scylla" is 1.48, which is somewhat below the average and indicates that the structure is rather heavy. It is always desirable, if a fair comparison is to be made, to specify what is included in the term "tare weight." In the case of the "Scylla" the expression includes very elaborate cabin furnishings, and this fact may partly account for the somewhat great weight. Another thing which may have played a part in putting up the empty weight is the necessity of designing the landing gear for an existing wing arrangement.

It is possible, although without knowing all the data it is impossible to express a definite opinion, that the use of metal covering for the fuselage has worked out rather heavier than would a fabric-covered structure. Altogether there may be many reasons for the slightly heavy tare weight of the airplane. The subject is one of interest mainly to aircraft engineers, and the "Scylla" as she stands is certainly capable of useful work on air lines.

CHARACTERISTICS

Dimensions:	ft.	in.	m
Length, over-all	83	10	(25.57)
Height, tail down	29	6	(8.99)
Wing span (upper)	113	0	(34.44)
" " (lower)	92	6	(28.19)
Wing chord	13	9	(4.19)
Length of fuselage	77	4	(23.57)
Maximum width of fuselage	11	6	(3.50)
Forward cabin, length	6	7	(2.00)
" " mean width	10	4	(3.15)
" " mean height	7	0	(2.13)
Aft cabin, length	21	10	(6.67)
" " mean width	10	9	(3.28)
" " mean height	7	4	(2.23)
Forward luggage compartment, length	2	4	(0.71)
" " " width	3	5	(1.03)
" " " height	7	4	(2.23)

Areas:	sq. ft.	m^2
Main wings	2,615	(242.94)
Ailerons	173	(16.07)
Stabilizer	206	(19.14)
Elevators	128	(11.89)
Fin	79	(7.34)
Rudder	73	(6.78)

Weights:	lb.	kg
Tare weight, equipped	22,650	(10,274)
Disposable load	10,850	(4,921)
Maximum gross weight	33,500	(15,195)

Performance:

As the "Scylla" had not, at the time of going to press been to Martlesham for official tests, no performance figures can be given. The performance is, however, almost identical with that of the "Scipio" class flying boat.

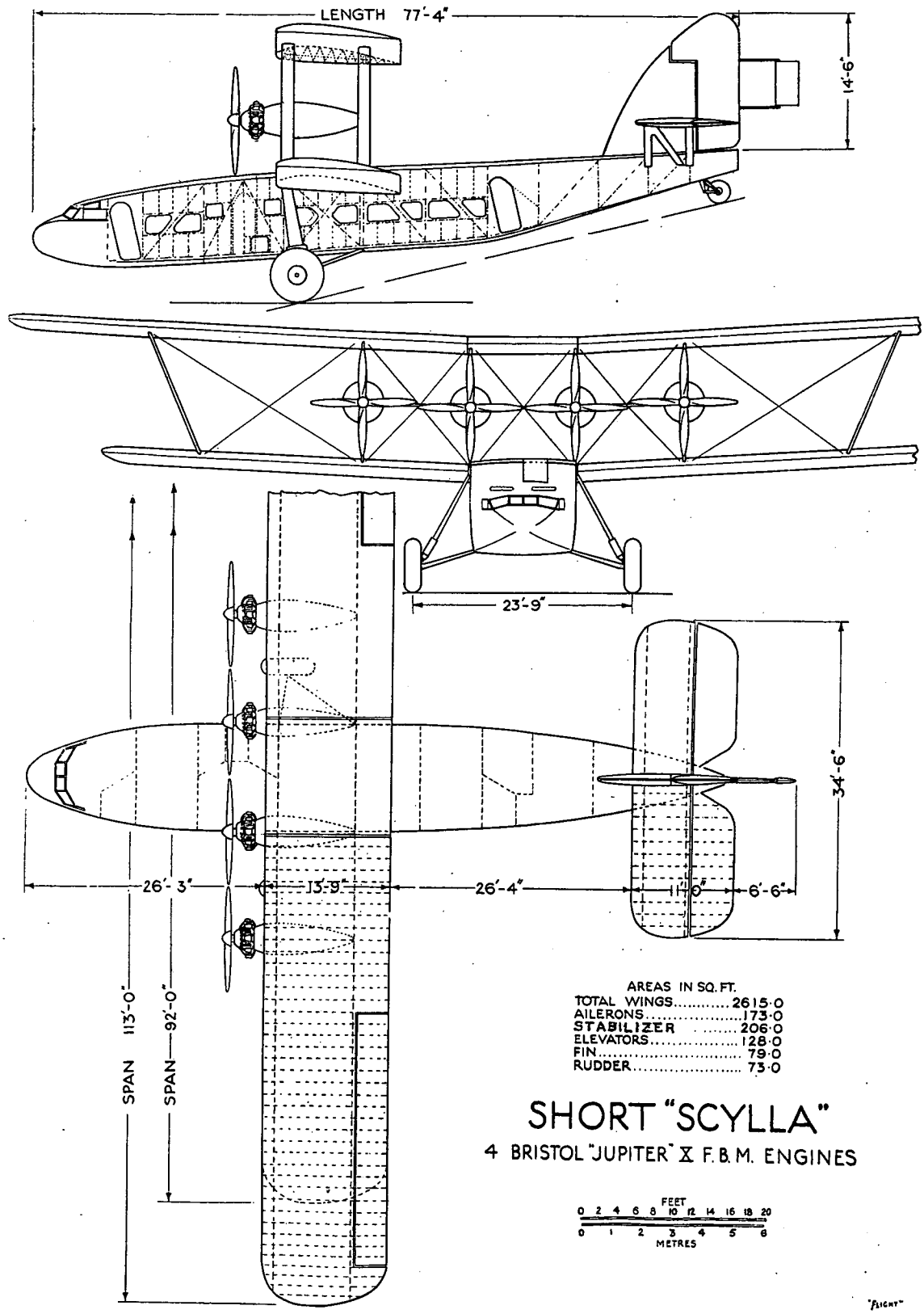


Figure 1.- General arrangement drawings of the Short "Scylla" airplane.

Figure 2

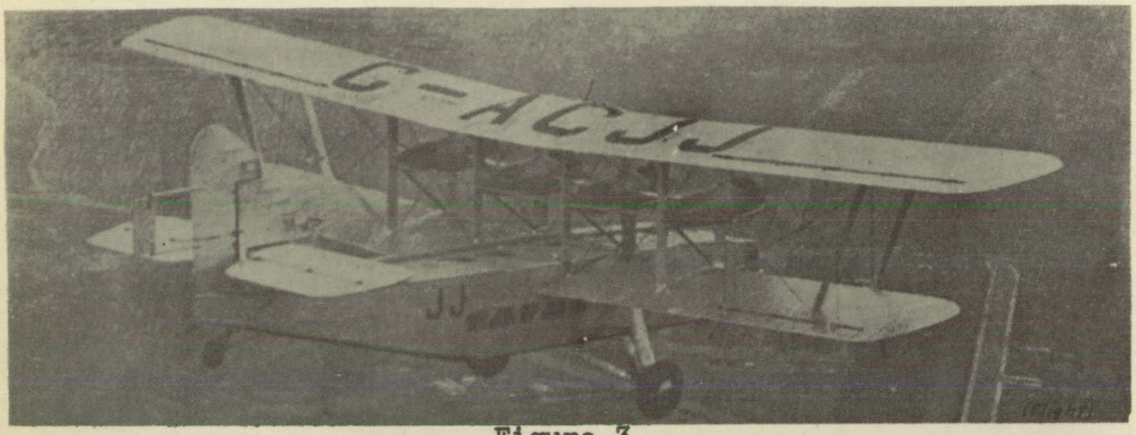


Figure 3

Figures 2,3.- The Short "Scylla" airplane making a test flight with nearly a full load, of (30,000 lb.) (Four Bristol "Jupiter" engines.)

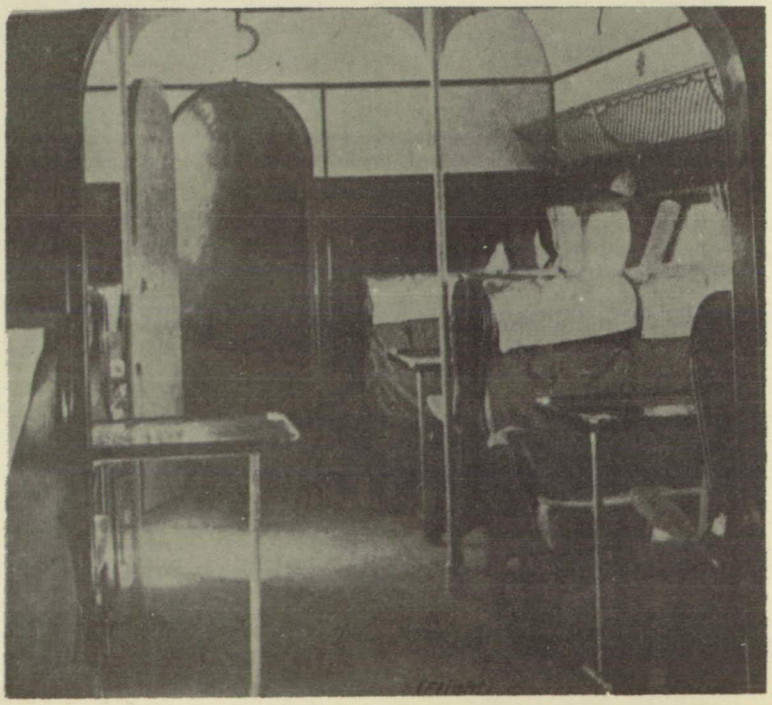


Figure 20.- A view in the rear cabin of the "Scylla". The mean width of the cabin is just under 11 ft.

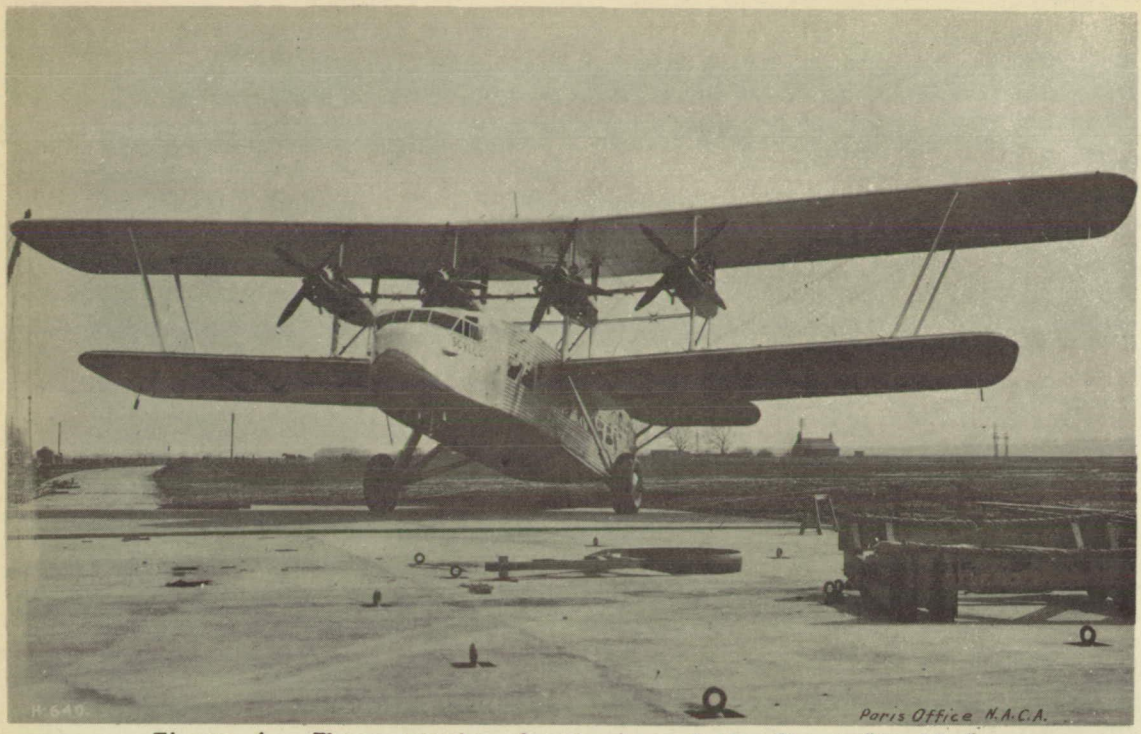


Figure 4.- Three-quarter front view of the Short "Scylla" 38-passenger air-liner.

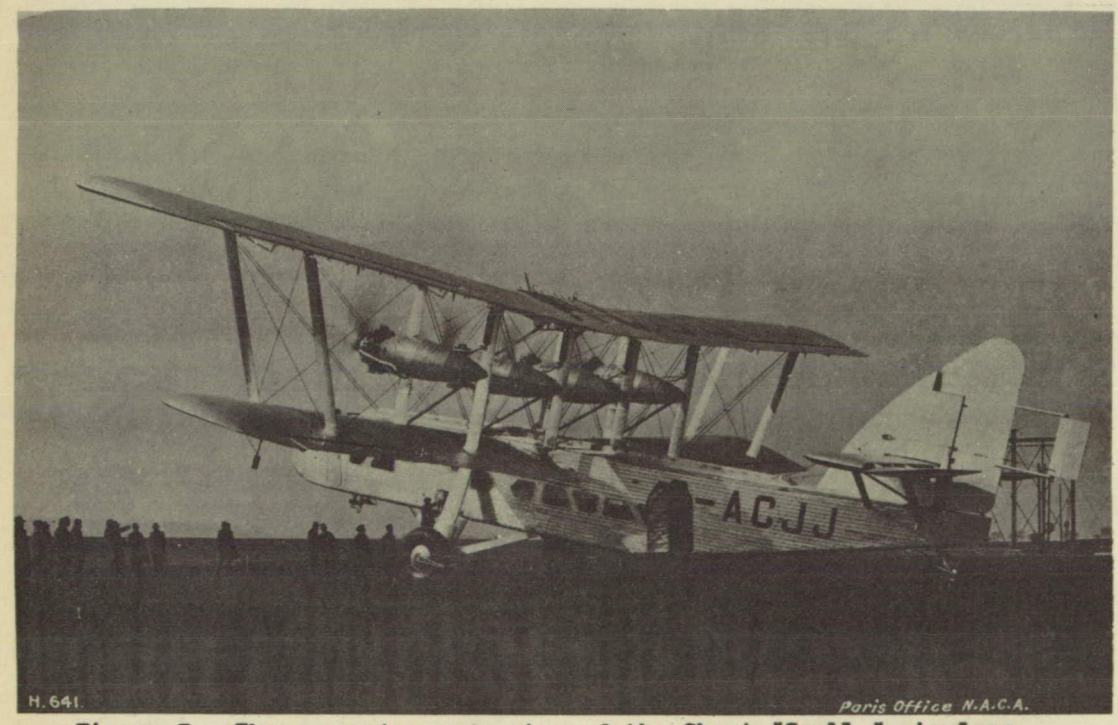


Figure 5.- Three-quarter rear view of the Short "Scylla" airplane.

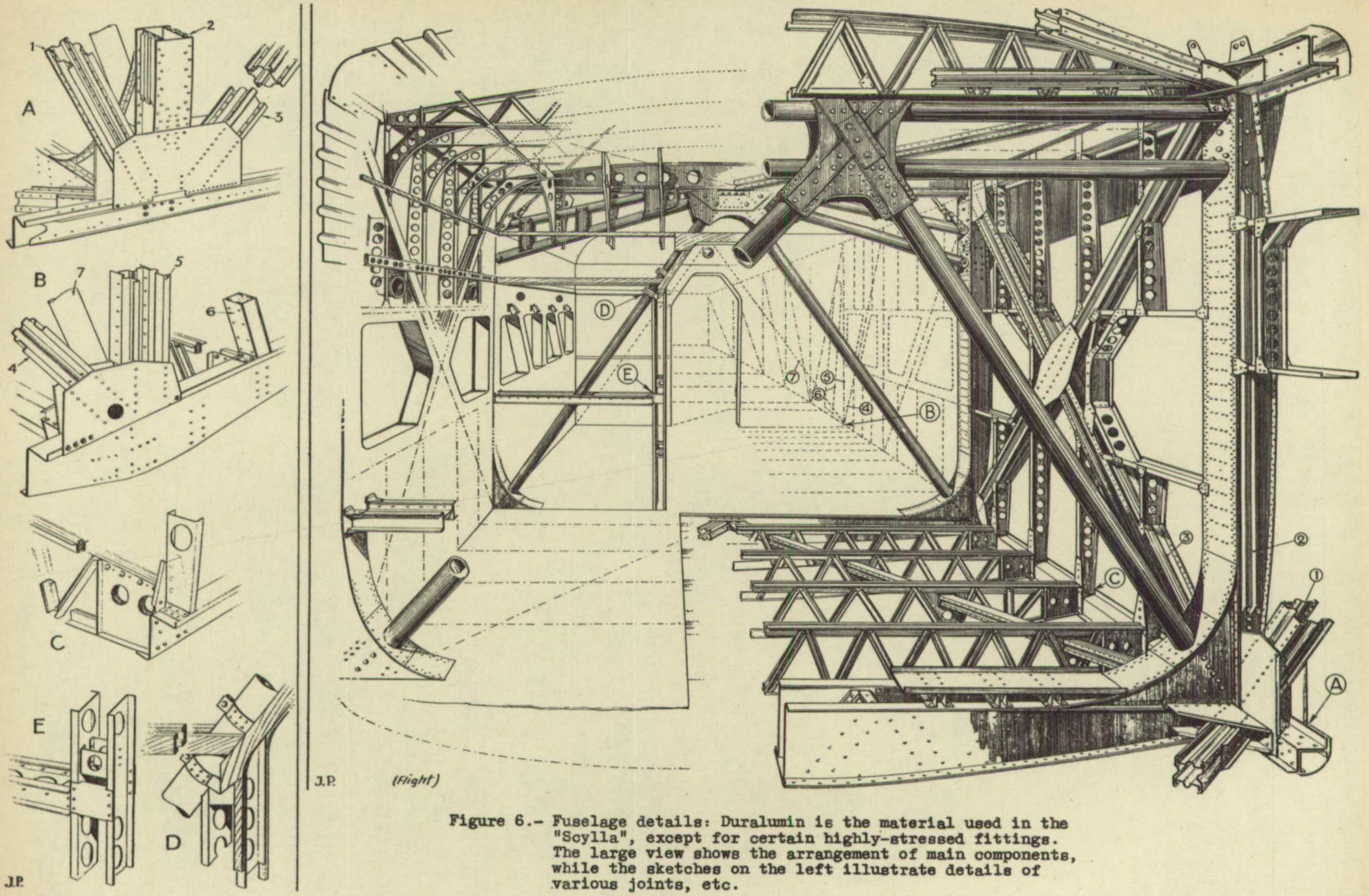


Figure 6.- Fuselage details: Duralumin is the material used in the "Scylla", except for certain highly-stressed fittings. The large view shows the arrangement of main components, while the sketches on the left illustrate details of various joints, etc.

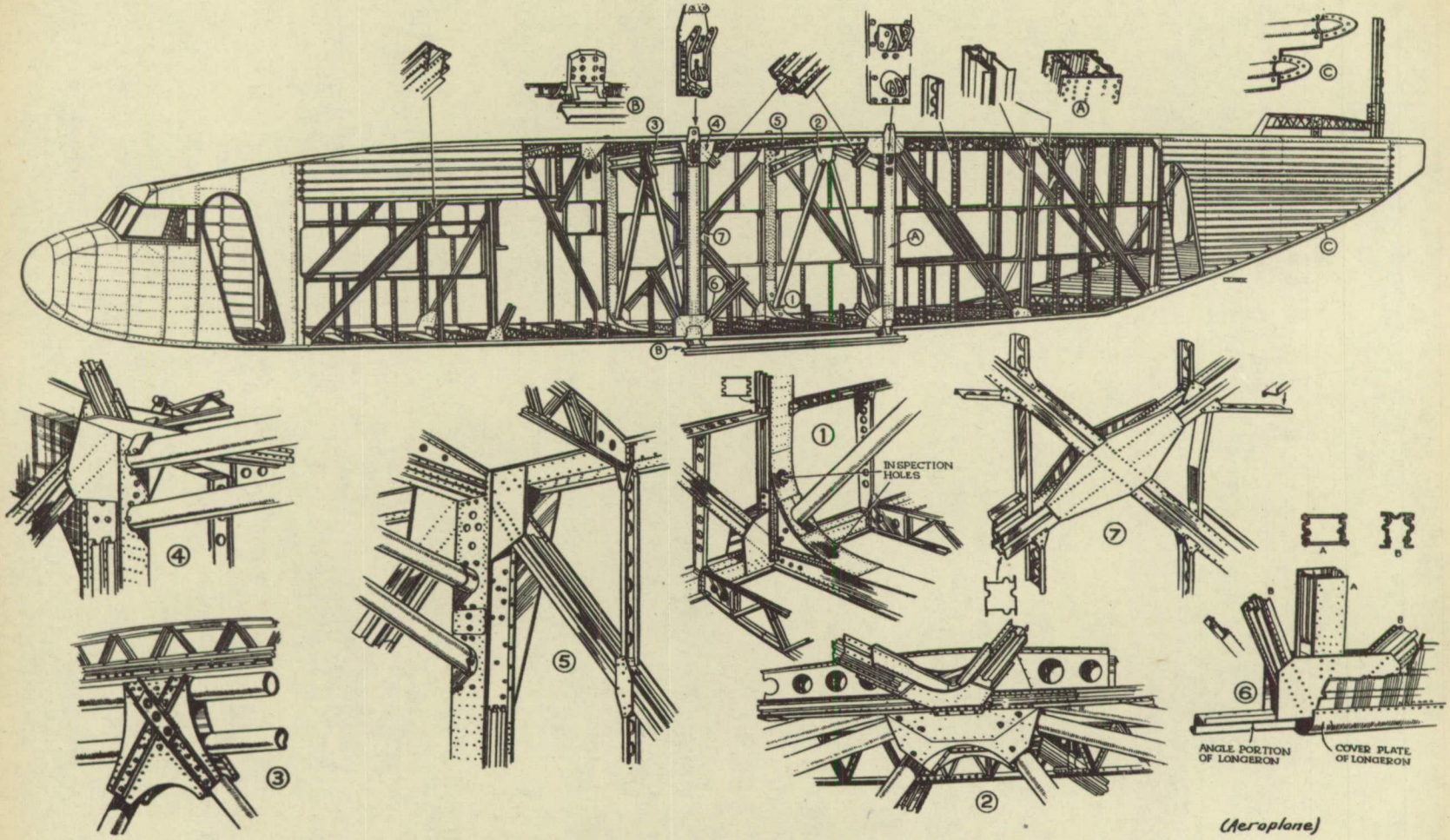


Figure 7.- The fuselage structure of the Short "Scylla", which shows a departure from the familiar system of construction.

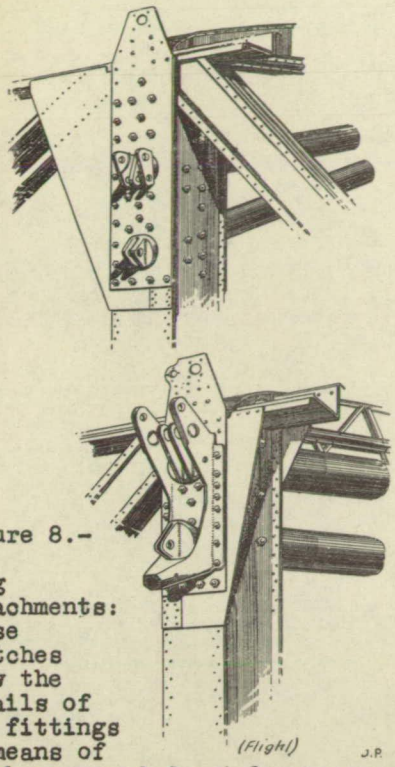


Figure 8.- Wing attachments: These sketches show the details of the fittings by means of which rear and front lower spars are secured to the top of the fuselage. The front spar fitting also takes the landing gear leg.

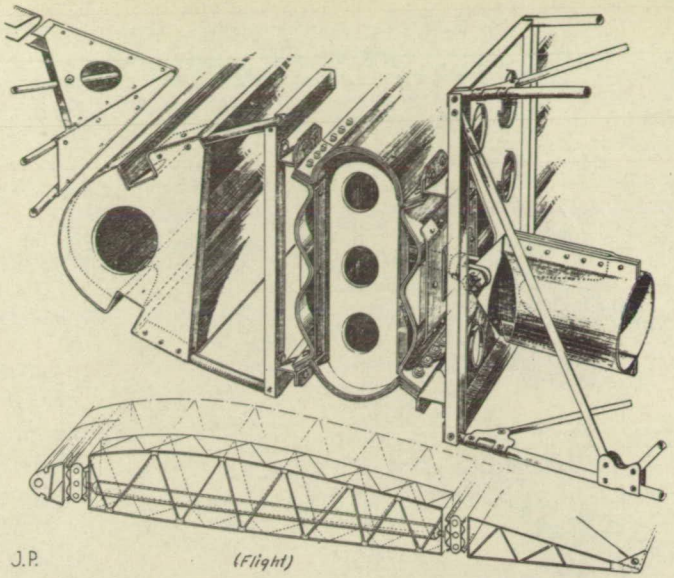


Figure 9.- Wing details: Duralumin spars and ribs, with steel fittings, are used in the Short "Scylla" airplane.

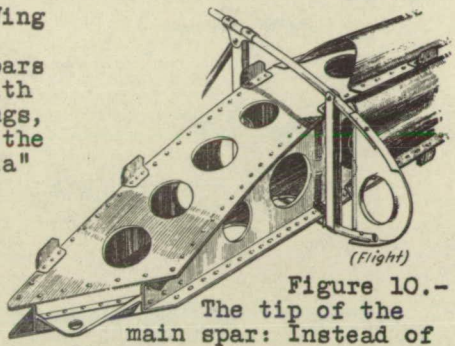


Figure 10.- The tip of the main spar: Instead of the corrugated section the tip becomes a plain box section.

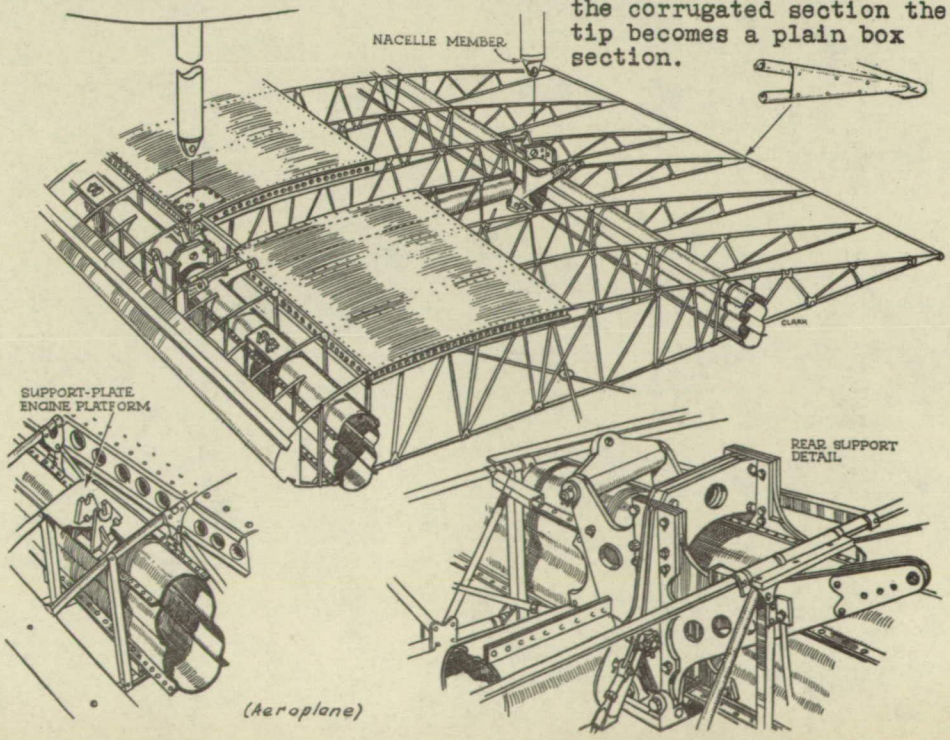
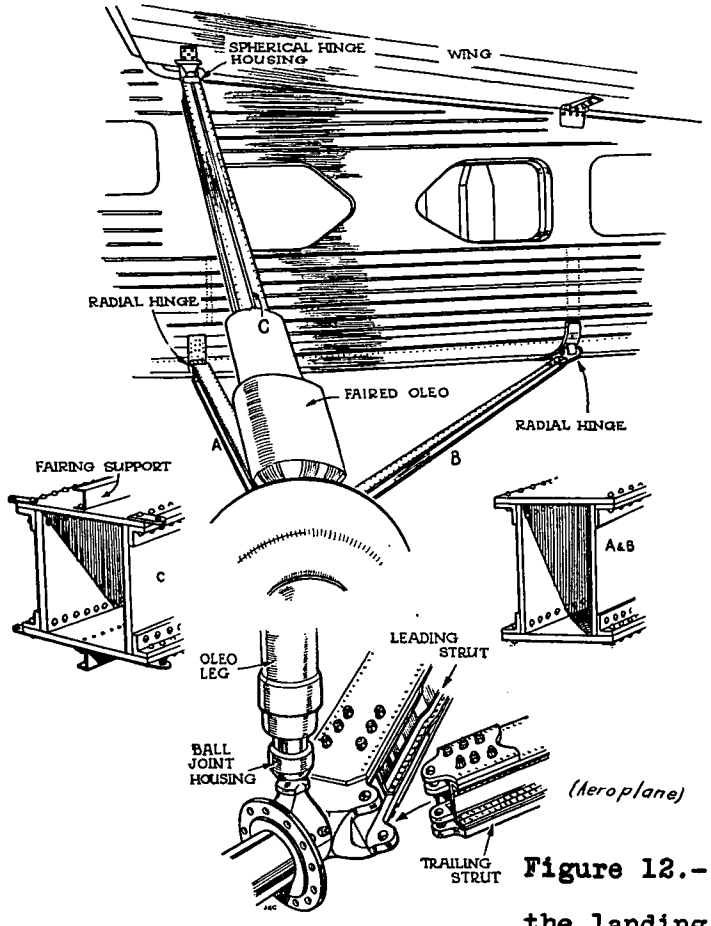


Figure 11.- Wing details: Sketches showing the typical Short wing structure used in the "Scylla" airplane.



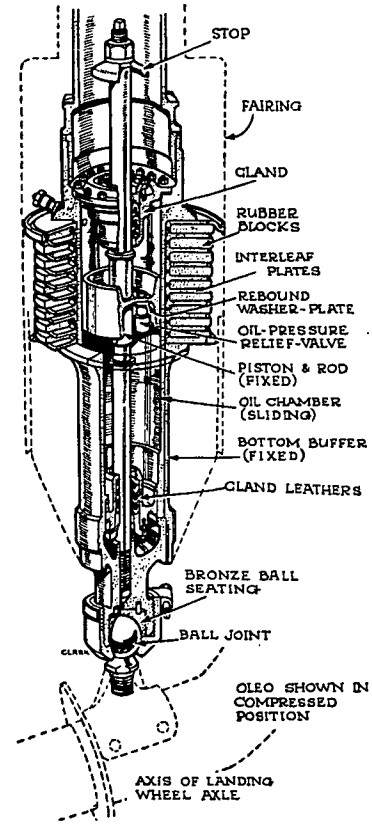


Figure 12.- The landing gear: Here is seen one side of the landing gear with details of the built-up struts. On the right is a section of the oleo unit which is designed for a load of 40 tons.

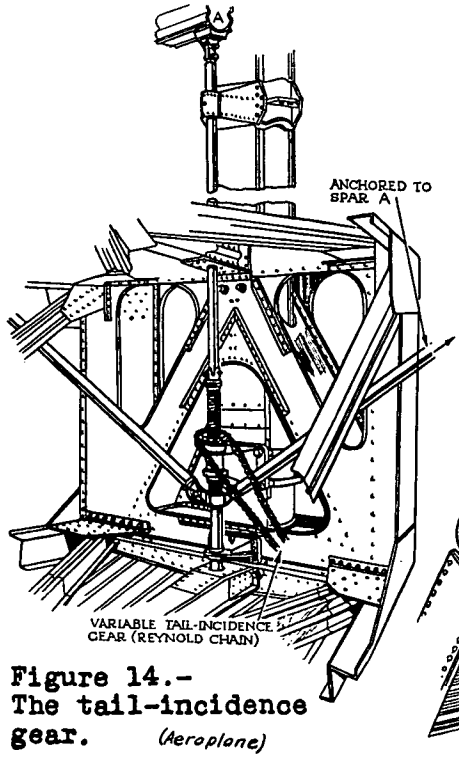


Figure 14.- The tail-incidence gear. *(Aeroplane)*

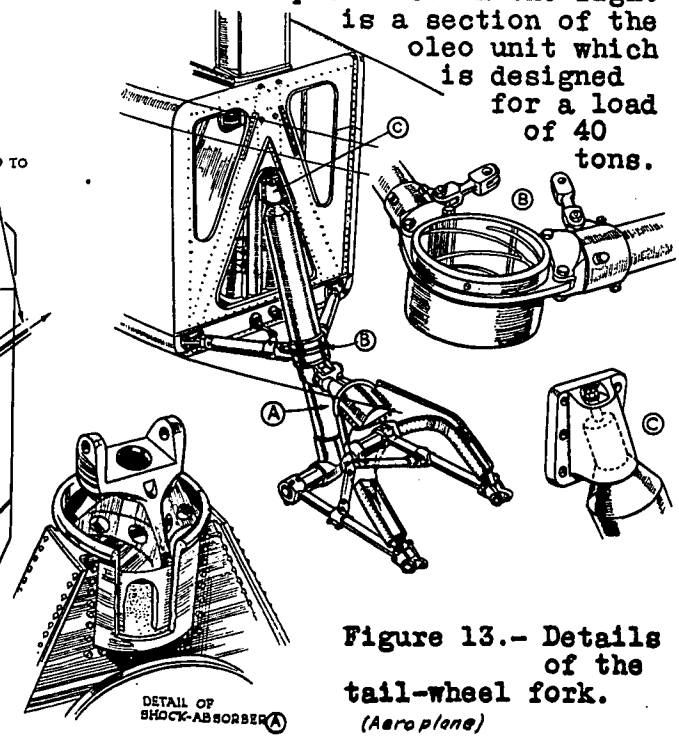


Figure 13.- Details of the tail-wheel fork. *(Aeroplane)*

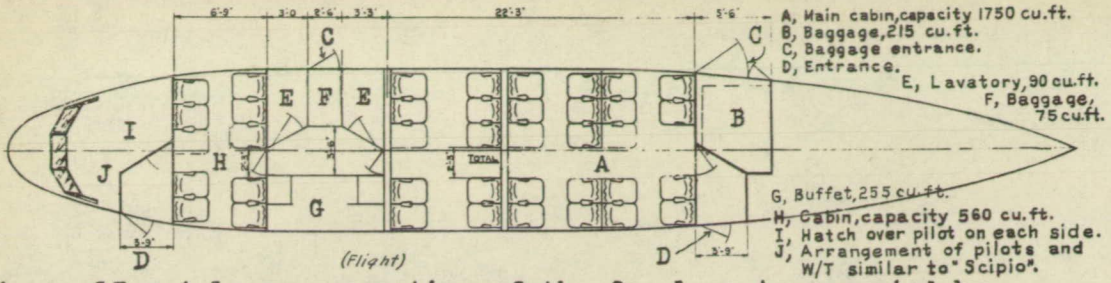


Figure 15.- A large proportion of the fuselage is occupied by the cabins which are roomy and have plenty of leg room.

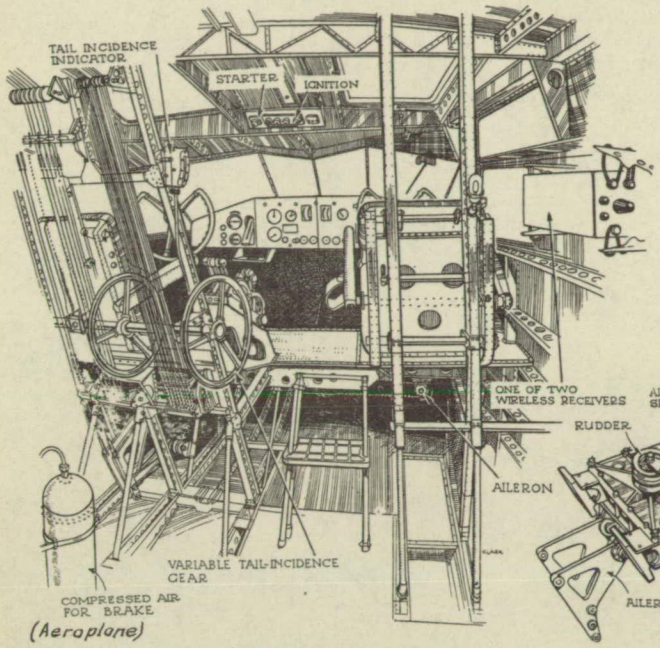


Figure 16.- A general view of the pilots compartment.

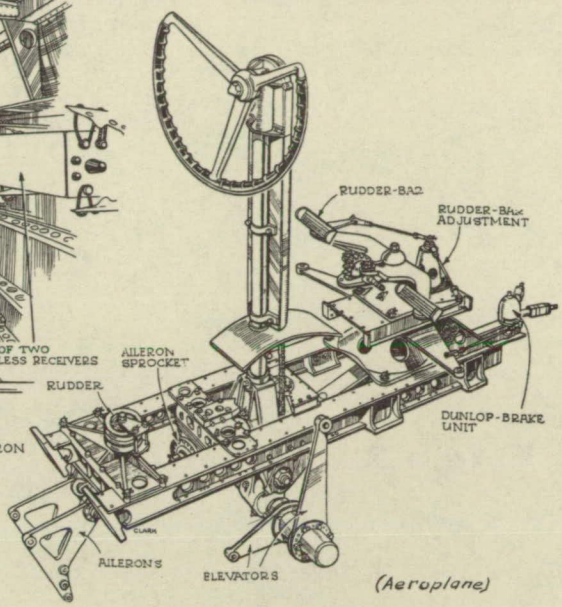


Figure 17.- One of the control units.

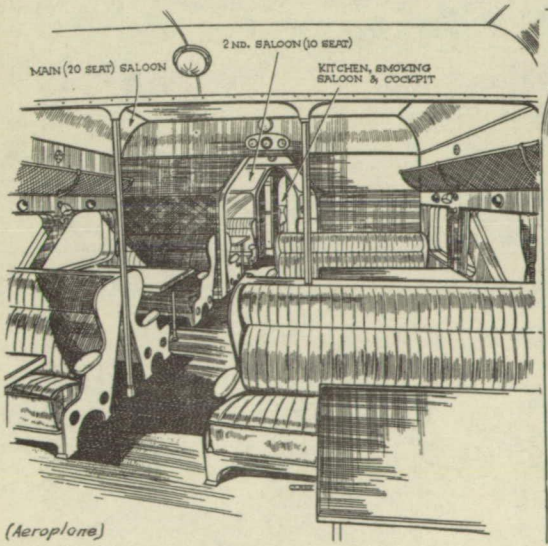


Figure 18.- View of the main saloon which seats 20 passengers.

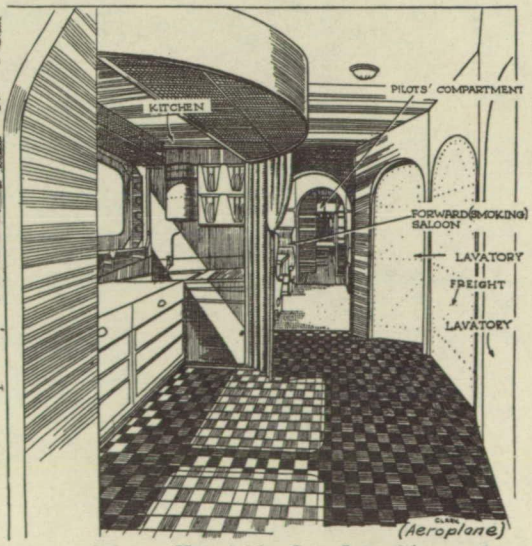


Figure 19.- Vestibule leading from the 2 nd. saloon to the forward smoking saloon.